

REMARKS

The Pending Claims

The pending claims are directed to a system for polishing a substrate comprising a liquid carrier, ammonium oxalate, a hydroxy coupling agent, and a polishing pad and/or an abrasive. The pending claims are also directed to a method of polishing a substrate using the same. Claims 1-27 currently are pending.

Discussion of the Specification Amendments

The specification has been amended to correct a typographical error appearing in the specification as filed. In particular, paragraph [0028] has been amended to replace a reference to comparative polishing systems “(B – I)” with “(B – H).” No new matter has been added by way of this amendment.

Summary of the Office Action

The Office Action rejects claims 1-8, 13, 15, 16-18, 20, 22-24, and 26 under 35 U.S.C. § 103(a) as allegedly obvious over U.S. Patent 6,582,761 (Nishimoto et al.) (hereinafter “the Nishimoto ‘761 patent”) in view of U.S. Patent 6,159,076 (Sun et al.) (hereinafter “the Sun ‘076 patent”). The Office Action also rejects claims 19, 21, 25, and 27 under 35 U.S.C. § 103(a) as allegedly obvious over the combination of the Nishimoto ‘761 and Sun ‘076 patents in further view of U.S. Patent 6,503,766 (Ni) (hereinafter “the Ni ‘766 patent”). The Office Action acknowledges that claims 9-12 and 14 recite allowable subject matter, but objects to the claims insofar as they depend from one or more rejected base claims.

Discussion of the Section 103 Rejections

The Office Action asserts that the Nishimoto ‘761 patent discloses an aqueous dispersion or a system for chemical-mechanical polishing comprising ion-exchanged water, ammonium persulfate, a silane coupling agent, a polishing pad, and a metal oxide abrasive. While the Office Action acknowledges that the Nishimoto ‘761 patent does not disclose or suggest a system comprising ammonium oxalate, the Office Action asserts that such a system would have been obvious to one of ordinary skill in the art in view of the Sun ‘076 patent. Applicants traverse the obviousness rejections.

As is well-settled, in order to establish a prima facie case of obviousness, three basic criteria must be met: (a) there must be some suggestion or motivation to modify the

reference or to combine reference teachings, (b) there must be a reasonable expectation of success, and (c) the prior art references must teach or suggest all the claim limitations. See e.g., M.P.E.P. § 2143. In the present case, the Office Action fails to properly identify a suggestion or motivation that would have motivated one of ordinary skill in the art, at the time of invention, to combine the cited references in such a way as to arrive at the invention defined by the pending claims.

The Nishimoto '761 patent discloses an aqueous dispersion of composite particles, which particles comprise an inorganic particle adhered to a polymer particle through a connecting compound (e.g., a silane coupling agent), useful as an abrasive in chemical-mechanical polishing (see, e.g., the Nishimoto '761 patent at col. 8, lines 3-30, and col. 17, lines 5-19). The Nishimoto '761 patent further provides that the aqueous dispersions described therein are useful for the polishing of a working film of a semiconductor device, such as a silicon oxide film, an amorphous silicon film, a polycrystalline silicon film, a single crystalline silicon film, a silicon nitride film, a pure tungsten film, a pure aluminum film, or a pure copper film, as well as films of tungsten, aluminum, and copper alloys and barrier metal layers (see, e.g., the Nishimoto '761 patent).

The Sun '076 patent is generally directed to a slurry comprising an abrasive (e.g., colloidal silica) and an additive containing a chemical group that effectively binds with a constituent of the surface to be polished (see, e.g., the Sun '076 patent at col. 3, lines 25-32). One example of a suitable additive discussed in the Sun '076 patent is ammonium oxalate (i.e., ammonium oxalate monohydrate). In particular, the Sun '076 patent discloses a slurry useful in the polishing of a nickel containing layer, such as a nickel-phosphorus (NiP) layer, comprising a colloidal silica abrasive, hydrogen peroxide, nitric acid, and ammonium oxalate monohydrate (see, e.g., the Sun '076 patent at col. 4, lines 47-64). While the Office Action is correct in noting that the Sun '076 patent discusses certain benefits allegedly realized by the addition of ammonium oxalate, the Sun '076 patent's discussion of those benefits and the purported mechanism of action are limited to the polishing of nickel-containing substrates. Indeed, the Sun '076 patent's discussion of the role of the ammonium oxalate is described with reference to reactions with nickel ions, as opposed to being broadly discussed in terms of reactions with all metal ions. Therefore, to the extent that the Sun '076 patent would have motivated one of ordinary skill in the art to utilize ammonium oxalate in a polishing composition, the Sun '076 patent would have only taught the use of ammonium oxalate in the polishing of nickel-containing substrates.

However, as noted above, the Nishimoto '761 patent does not teach or suggest that the aqueous dispersions described therein are useful for the polishing of a nickel-containing

substrate. Rather, the Nishimoto '761 patent is directed toward the polishing of a working film of a semiconductor device. Therefore, contrary to the Office Action's assertions, one of ordinary skill in the art, having read the Nishimoto '761 patent, would not have looked to the Sun '076 patent because it is concerned with the polishing of different substrates. Moreover, even if one of ordinary skill in the art did look to the Sun '076 patent, the Sun '076 patent's teachings would not have motivated the ordinary artisan to modify the Nishimoto '761 patent in such a way as to arrive at the invention because those teachings are directed towards the polishing of nickel-containing substrates, not the semiconductor working films of the Nishimoto '761 patent, and the cited references fail to teach or suggest that the same benefits would be realized if ammonium oxalate were used to polish other substrates. In other words, one of ordinary skill in the art would not have expected that, based on the cited references, the addition of ammonium oxalate to a polishing slurry would yield an increase in the removal rate of a non-nickel substrate similar to the increases reported in the Sun '076 patent for nickel-containing substrates. Therefore, the Office cannot properly assert that the Sun '076 patent would have motivated one of ordinary skill in the art to modify the aqueous dispersions of the Nishimoto '761 patent in such a way as to arrive at the invention defined by the pending claims.

The Ni '766 patent does not cure the deficiencies of the Nishimoto '761 and Sun '076 patents. The Ni '766 patent relates to a method and system for detecting an exposure of a material on a semiconductor wafer during chemical-mechanical polishing (see, e.g., the Ni '766 patent at the abstract). The Ni '766 patent does not, however, describe the chemical-mechanical polishing system to be employed in a polishing method or system according to the invention described therein. Therefore, the Ni '766 patent cannot properly be considered to supplement the teachings of the Nishimoto '761 and Sun '076 patents in such a way as to motivate one of ordinary skill in the art to combine the cited references and arrive at the invention defined by the pending claims.

Moreover, as demonstrated in the specification, the invention provides unexpected results that are sufficient to overcome any *prima facie* obviousness rejection based upon the cited references. In particular, the example set forth in the present specification clearly demonstrates that a system comprising the combination of a liquid carrier, ammonium oxalate, a hydroxy coupling agent, and a polishing pad and/or an abrasive exhibits a copper removal rate that is at least about 130% greater than the removal rate exhibited by similar polishing compositions. A comparison of the inventive polishing system (i.e., polishing system I) with comparative polishing systems D, F, G, and H reveals that polishing systems comprising different oxalate salts or different ammonium salts (i.e., oxalate and ammonium

salts other than ammonium oxalate) fail to exhibit the relatively high removal rates observed with the polishing system of the invention. Indeed, each of comparative polishing systems D, F, G, and H exhibited copper removal rates that were lower than the copper removal rate exhibited by the control polishing system, which did not comprise a polishing additive. However, as noted above and in the present specification, the combination of ammonium and oxalate (i.e., ammonium oxalate) exhibited a two-fold to three-fold increase in the copper removal rate relative to the comparative polishing systems.

The dramatic increase in the removal rate exhibited by the inventive polishing system also departs from the teachings of the cited references. In particular, the Sun '076 patent teaches that the increased nickel removal rate observed for the polishing slurry containing ammonium oxalate is principally due to the fact that the oxalate ions chelate the nickel ions on the surface of the substrate (see, e.g., the Sun '076 patent at col. 6, lines 10-19). The Sun '076 patent also teaches that the presence of ammonium ions does not affect the nickel removal rate of a polishing slurry (see, e.g., the Sun '076 patent at col. 6, lines 37-45). Thus, the combined effect of the ammonium oxalate on the copper removal rate observed for the inventive polishing system departs from the teachings of the cited references. Accordingly, one of ordinary skill in the art, at the time of invention, would not have expected the claimed combination to exhibit such a dramatic increase in the removal rate relative to similar polishing systems.

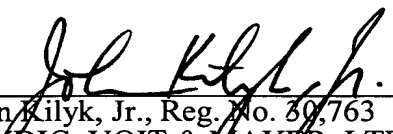
In view of the foregoing, the invention defined by the pending claims cannot properly be considered obvious over the cited references. In particular, one of ordinary skill in the art, at the time of invention, would not have been motivated to combine the references in such a way as to arrive at the invention defined by the pending claims. Moreover, the claimed invention exhibits unexpected results sufficient to overcome any obviousness rejection based on the cited references. The Section 103 rejections, therefore, should be withdrawn.

In re Appln. of Chou et al.
Application No. 10/043,534

Conclusion

The application is considered in good and proper form for allowance, and the Examiner is respectfully requested to pass this application to issue. If, in the opinion of the Examiner, a telephone conference would expedite the prosecution of the subject application, the Examiner is invited to call the undersigned attorney.

Respectfully submitted,



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